The Failed Block

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OBJECTIVES

At the conclusion of this presentation, the participant will be able to:

- Describe the anesthetic options for elective upper extremity surgery
- Discuss local anesthetic options for regional anesthesia for the upper extremity
- Present features of regional anesthesia that influence patient satisfaction
- Describe techniques for confirming needle localization
- Discuss controversy associated with interventional elicitation of paresthesia
- Describe techniques to verify successful brachial plexus block
- Discuss strategies for dealing with incomplete block
- Describe the risks of upper extremity peripheral nerve block

STEM CASE - KEY QUESTIONS

Stem Case: The patient is a 40 year old, 6'2", 90Kg male who sustained a fracture of both bones of the forearm in a bicycle accident and is scheduled for ORIF. He is an aerobic athlete, completely healthy and prefers regional anesthesia. The surgeon plans 2 hours.

Key Question 1: What is the best anesthetic choice for this patient?

Key Question 2: What are the regional anesthetic options for this surgical procedure?

Key Question 3: What local anesthetic solution would you select?

Key Question 4: How will you confirm the placement of the regional anesthesia?

Key Question 5: An axillary brachial plexus block is selected and 40ml of 1.4% mepivacaine, 1/200,000 epinephrine with added bicarbonate is injected using a transarterial technique. How will you verify that a complete block is the result?

Key Question 6: 20 minutes after completion of injection, the block is incomplete. What are your options?

Key Question 7: Patient still strongly prefers regional anesthesia. Will you continue to attempt to provide regional anesthesia?

Key Question 8: What are the limits to the local anesthetic dose that can be used for the second attempt at regional anesthesia?

Key Question 9: There is complete anesthesia of the forearm except for sparing of the ulnar nerve. Will you perform a repeat plexus block or an isolated ulnar block? At what level?

Key Question 10: Are there unique risks associated with isolated nerve blocks of the upper extremity?

PROBLEM BASED LEARNING DISCUSSION

The choice of regional anesthesia for extremity procedures is a reasonable option for many patients. Patient choice is an important determinant, and many patients will actively seek regional anesthesia based on a favorable previous experience or the report of a family member (1). The majority of patients who have shoulder surgery with regional anesthesia have a favorable experience and have a decreased incidence of minor complications (nausea, sore throat), improved acute pain control and less blood loss intraoperatively (2). Prior adverse experience by the patient or a member of the family can influence the patient in a negative manner, and the result is either reluctance or absolute refusal to accept regional anesthesia (3). Although the satisfaction with regional anesthesia seems to be high, and the majority of physicians prefer regional anesthesia for themselves, the measurement of patient satisfaction is difficult and it is impossible to separate factors that determine satisfaction from the procedures that measure satisfaction (4).

Use of regional anesthesia is determined by many factors including the experience during residency by the Anesthesiologist and by the numbers of times that a given block has been performed by the individual anesthesiologists. This is extremely variable from one hospital to the next, perhaps because of the variability in the exposure to regional anesthesia (5). It is clear that more repetition increase confidence with regional anesthesia and the probability that a given anesthesiologists will use a particular block in his practice (6).

When a patient selects regional anesthesia for an upper extremity procedure, the anesthesiologist must select a particular block. As previous mentioned, some of this choice will be determined by prior experience, but the choice should also be modified by the variability of success rates and the probability of achieving a complete block with a given technique. For this procedure, motor block of the major terminal nerves in important to achieve acceptable conditions for the surgeon. An interscalene block might not be the best choice, due to the high incidence of sparing the ulnar nerve (7).

The choice of local anesthetic is also subject to wide variability among anesthesiologists. For peripheral nerve block, many select a solution with epinephrine added. The rationale for added epinephrine is to prolong the block with some agents (including mepivacaine), decrease the plasma level achieved (reducing the risk of CNS toxicity), and as a marker to identify intravascular injection (8). All of these factors apply to the choice in this case, since a prolonged block is optimum for surgical anesthesia and acute pain control, a large total dose of the drug was used and a transarterial technique makes intravascular injection a significant issue in this case. The decision to alkalinize the local anesthetic prior to injection is subject to a lot of individual choice. The intermediate duration amide agents (lidocaine and mepivacaine) and the esters can be alkalinized to near physiologic pH using known schedules (9). The more lipid soluble amides, bupivacaine, ropivacaine and levobupivacaine, are limited to a pH less than 6.5 by precipitation. The advantages of alkalinization are reduced pain with injection (10), accelerated speed of onset (11), increased depth of block (12), improved block of large nerve roots with epidural injection (13), improved motor block (14) and reduced tourniquet pain (15).

Another variable in plexus blockade is the technique used to localize the neural structures for the intended blockade. The brachial plexus block intended for this patient could have been performed by elicitation of paresthesia, use of a nerve stimulator, perivascular technique or

transarterial technique. There is controversy about paresthesia technique, related to the possible association of paresthesia with postoperative nerve injury after regional anesthesia. This had caused many to advocate the use of a nerve stimulator to improve success rate with regional anesthesia without causing paresthesia. The success rate may be improved (or at least very good) in some reports (16), but the use of a nerve stimulator does not eliminate the potential for paresthesia or the risk of nerve injury from paresthesia (17). The controversy surrounding paresthesia has resulted in many reports with speculative and/or substantive data. A theoretical risk with multiple injection technique is presented with the idea that second and subsequent insertions of the needle could cause silent neural injury (18). Blunt needles used for paresthesia technique may reduce trauma to the nerves with elicited paresthesia (19). Intraneural injection causes disruption of axonal structure, especially with epinephrine or very high concentrations of local anesthetic (20). Even in cases where paresthesia was not intended, they were encountered in 40% and nearly 25% of these had persistent paresthesia after blocks with non-blunt needles (21). Transarterial technique is reported as a safe alternative to paresthesia, although compressive hematoma has been reported with associated neural injury (22). The ultimate significance of these postoperative neurological changes may not be significant- a large number can be found, but most are very transient (23).

Whether the technique to perform the block influences the ultimate success rate has been extensively reviewed. If paresthesia technique is selected, improved success occurs when the paresthesia elicited is within the primary dermatomes to be operated on (24). In a teaching environment, three techniques (paresthesia, nerve stimulator, transarterial) were compared and no differences found (25). A single-site injection behind the axillary artery with transarterial technique had a uniform very high success rate (26). Multiple site injection with transarterial injection did not improve outcome (27). Transarterial technique not only resulted in very high success, but in a large series had very few neurological issues post-block (28).

Once the block has been performed, the density of the block must be evaluated. Many reports seem to have different outcomes in the completeness of neural block using the same technique. The reason for this variation is probably related to the complexity of sensory assessment- many of these studies are “apples and oranges” when compared (29). The importance of the assessment is highlighted by the extremely variable sensory and motor block that results from routine axillary block by all techniques. The variability of the anatomy and the movement of local anesthesia within the sheath of the brachial plexus is the obvious explanation (30). If the local anesthetic is injected close to the neural structures that are most within the dermatomes of the surgery, the probability of complete block is highest (31). Single or multiple injections of the local anesthetic do not change the outcome (32).

If there is incomplete neural block, the choices are multiple. Some will elect to use general anesthesia for expedient reasons. Repeating the block always raises the issue of toxicity of the local anesthesia. A full-dose with repeat block immediately after the original block would carry a high risk of toxicity. If an interval passes and the doses is reduced, the risk is significantly less (33). As an alternative, peripheral blocks can be performed to complete the anesthesia and motor block of a spared terminal nerve. Although some anesthesiologists have been taught that peripheral blocks may have an increased risk of nerve injury, they can be safely performed if precautions are taken to avoid intraneural injury, such as using field block or a nerve stimulator.

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